FAA-E-2477a
June 2, 1975
SUPERSEDING
FAA-E-2477, 3/23/72

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

RECORDING SYSTEM, HIGH CAPACITY VOICE

1. SCOPE

1.1 Scope.- This specification sets forth the requirements for a recording-reproducing system which will provide (1) a record system with a capability of recording up to 152 audio channels and one digital time channel for a 16.5 hour time period, (2) a cabinet containing a reproducing system and tape copier, (3) a test fixture, and (4) may include a magnetic tape bulk degausser unit.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA specifications, standards, and drawings, of the issues specified in the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA specifications

FAA-E-163b Amendment-2 Spec Chg 3	Rack, Cabinet, and Open Frame Types
FAA-G-2100/1b Amendment-2	Electronic Equipment, General Requirements; Part I, General Requirements for All Equipments
FAA-G-2100/3a	Part 3, Requirements for Equipments Employing Semiconductor Devices

FAA-G-2100/4b Part 4, Requirements for Equipments Employing Printed Wiring Techniques

FAA-G-2100/5 Part 5, Requirements for Equipments Employing Microelectronic Circuits

FAA-E-2306 Amendment-1 Changes 1 & 2 Coded Time Source and Auxiliaries

FAA-D-2494/1a Instruction Book Manuscripts, Technical: Equipment and Systems, Requirements Part 1 - Preparation of Manuscript

FAA-D-2494/2a Part 2 - Preparation of Reproducible Copy and Original Artwork

2.1.2 FAA standards

FAA-STD-992a Engineering Drawings

FAA-STD-007 PERT Procedures for Contract Use

FAA-STD-012a Paint Systems for Equipment

FAA-STD-013a Quality Control Program Requirements

2.2 Military and Federal publications.- The following Military and Federal publications of the issues in effect on the date of the invitation for bids form a part of this specification.

2.2.1 Military specifications

MIL-E-175555G Electronics and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of

MIL-J-641G Jack, Telephone, General Specification for

2.2.2 Military standards

MIL-STD-461 Electromagnetic Interference Characteristics, Requirements for Equipments

MIL-STD-470 Maintainability Program Requirements

MIL-STD-471 Maintainability Demonstration

MIL-STD-721 Definitions of Effectiveness, Terms of Reliability, Maintainability, Human Factors, and Safety

MIL-STD-781B Reliability Tests; Exponential Distribution

MIL-STD-785A Requirements for Reliability Program

MIL-STD-1472A Human Engineering Design Criteria for Military Systems, Equipment, and Facilities

2.2.3 Military handbook

MIL-HDBK-217A Reliability Stress and Failure Rate Data for Electronic Equipment

MIL-HDBK-472 Maintainability Prediction

2.2.4 Federal specifications

W-R-175b Reels and Hubs for Magnetic Recording Tape

W-R-175/4 Reel, Precision, Aluminum and Magnesium, Three-inch Center Hole

2.3 Other specifications

IRIG-106-73 Telemetering Standards

IRIG-118-73 "Test Method of Telemetry Systems and Subsystems"

(Copies of FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration Office, Washington, D.C. 20591. Request should fully identify material desired, i.e., specification numbers, dates, amendment numbers, and complete drawing numbers. Request should state the contract involved or other use to be made of the requested material.)

(Single copies of Military specifications may be requested by mail or telephone from U.S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. For telephone requests call 215-697-3321, 8:00 a.m. to 4:30 p.m., Monday through Friday. Not more than five items may be ordered on a single request; the Invitation for Bid or Contract Number should be cited where applicable. Only latest revisions (complete with latest amendments) are available; slash sheets, such as MIL-E-1/305, must be individually requested. Request all items by document number.)

(Copies of Federal specifications and standards may be obtained for bidding purposes at General Services Administration regional offices in Boston; New York; Washington, D.C.; Atlanta; Chicago; Kansas City, Missouri; Dallas; Denver; San Francisco; Los Angeles; and Seattle, Washington.)

(Copies of IRIG specifications may be obtained from the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, Springfield, Virginia 22151.)

3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- Each equipment furnished by the contractor shall be complete and in accordance with all specification

requirements and shall include the items tabulated below. Instruction books shall be furnished in accordance with Specification FAA-D-2494/1a and /2a in quantities specified in the contract schedule, unless otherwise specified

Description

(a) Magnetic tape record system (paragraph 3.4)
(b) Magnetic tape reproduce system with tape copier (paragraph 3.5)
(c) Magnetic tape bulk degausser (paragraph 3.6)
(d) Cabinets (paragraph 3.8.1)
(e) Cables (paragraph 3.8.6)
(f) Test tape (paragraph 3.10.1)
(g) Text fixture (paragraph 3.7)
(h) Tape reels (paragraph 3.3.2)

3.1.1 Time code generator.- The time code generator shall not be furnished by the contractor as a part of the high capacity recording system. However, a digital time code generator, with a time code in accordance with Specification FAA-E-2306, Amendment 1, and Specification Changes 1 and 2 shall be provided by the contractor for performing the test as required in paragraph 4.3.

3.1.1.1 Digital time code track.- The digital time code will be recorded alone on one tape track (#42). The digital time code track shall have:

(a) A noise level no greater than -30 dBm
(b) hum distortion no greater than -35 dBm
(c) A crosstalk signal no greater than -30 dBm

3.1.2 Audio filter.- Unless otherwise specified in the contract schedule, an audio filter (as described in 3.5.13) shall be furnished.

3.1.3 Tape degausser unit.- Unless otherwise specified in the contract schedule, a tape degausser unit (described in paragraph 3.6) shall be furnished. The contractor shall consult the contract schedule to determine the quantity of tape degausser units to be furnished.

3.2 Definitions

3.2.1 Normal test conditions.- The term "normal test conditions" is defined as a group of parameters listed below.

AC line voltage, 120 $\pm$ 5 volts
AC line frequency, 60 $\pm$ 0.5 Hz
Temperature, $30^{o} \pm 10^{o}$

3.2.2 Service conditions.- The term "service conditions" is defined as a group of parameters listed below (for equipment installed in an attended facility).

Duty, Continuous, unattended
AC line voltage, 105 to 130 volts
AC line frequency, 60 Hz ± 3 Hz
Elevation, 0 - 10,000 feet above sea level
Temperature, + 10° C to + 50° C
Relative humidity, 10 percent to 80 percent

3.2.3 Channel.- The term "channel" shall in all cases refer to data or voice source of which several are multiplexed on one tape track for recording purposes.

3.2.4 Hum distortion frequency.- A hum distortion frequency is defined as any frequency appearing in the output circuit resulting from the combination of the signal frequency and the fundamental or any harmonic of the power supply frequency.

3.2.5 Tape track.- The term "tape track" shall refer to the data into or out of any one head of the record-reproduce system.

3.3 Record and reproduce transport requirements.- The tape transports on both the record and reproduce systems shall meet the requirements of the following subparagraphs.

3.3.1 Transport design.- The record and reproduce system transports shall be of the same basic design and shall utilize identical parts and subassemblies where feasible.

3.3.2 Tape reels.- Each tape transport shall utilize supply and take-up reels with a maximum diameter of 15 inches that are in accordance with Federal Specifications W-R-175b and W-R-175/4. The tape reels shall be mounted parallel to and on the front of the panel door with reel centers, one above the other, on the same vertical line. The take-up reel shall be provided and located in the lower position of the transport.

3.3.3 Tape.- Each tape transport shall utilize magnetic tape meeting the requirements of the following subparagraphs. Tape reels shall not utilize spliced tape within the total required lengths to meet all specification requirements.

3.3.3.1 Physical requirements.- The tape will have the following physical characteristics:

(a)	Polyester back	1 mil thick approximately
(b)	Coating:	0.2 mil thick
(c)	Width:	1 inch + 0.000 - 0.004
(d)	Static tensile yield strength:	3.2 lbs per 1/4 inch width min.
(e)	Elongation under stress:	0.150 percent max.
(f)	Shock tensile strength:	>0.59 ft-lbs per 1/4 inch wide tape min.

3.3.3.2 Magnetic requirements.- The tape will have the following magnetic characteristics:

(a)	Coercivity:	290 Oersteds max.
(b)	Retentivity:	960 Gauss max.
(c)	Remanence:	0.32 lines per 1/4 inch width max.
(d)	Erasing field required:	1000 Oersteds max.

3.3.4 End-of-tape and broken tape sensor.- Each transport shall be equipped with an end-of-tape sensor and broken tape sensor. Mechanical contact with the oxide surface of the tape shall not be permitted. Actuation of the sensor shall apply reel brakes. Special leaders or tape modification shall not be used.

3.3.5 Braking system.- Each transport shall be equipped with a braking system which is automatically actuated in the event of a power failure, tape breakage, or if either reel runs out of tape. The machine shall stop without damage to the tape if a power failure occurs.

3.3.6 Flutter.- Flutter at the recording speed shall not exceed 1.0 percent peak-to-peak, 2 sigma, over a bandwidth of 0.5 Hz to 313 Hz. Flutter shall be measured in accordance with paragraph 5.2.2.3 of IRIG-118-73.

3.3.7 Dynamic skew.- At the recording speed in the forward direction, the transport shall have no more than 15.0 microseconds peak-to-peak of dynamic skew, measured between adjacent tracks of the same head stack.

3.3.8 Head alignment.- Head assemblies shall be prealigned at the factory. No special tools or alignment shall be necessary when replacing heads. The head assemblies shall be readily accessible for cleaning.

3.3.9 Tape speed accuracy.- At the recording speed, tape speed accuracy shall be within 0.15 percent, as measured in accordance with IRIG-118-73 paragraph 5.2.2.2.2.

3.3.10 Start time.- The transport shall meet all flutter and speed specifications within 3 seconds after the start command.

3.3.11 Stop time.- At the recording speed, the transport shall stop within 1 second after the stop command.

3.3.12 Head polarity.- Head polarity shall conform to the requirements of IRIG-106-73 paragraph 5.6.2.2.5.

3.4 Record system.- The requirements of the following subparagraphs apply only to the record system.

3.4.1 Record system.- The record system shall consist of two transports, a common electronics package, a switching circuit, an automatic monitor, a channel monitor, a common connector panel, a power supply system, and a dual bias oscillator.

3.4.1.1 Dual transports.- The two tape transports provided as part of the basic record system shall be herein defined as the operating or standby transport dependent upon its operational status. The transport which is in fact recording shall be defined as the operating transport. The second transport, defined as the standby transport, which may be fully powered, shall normally be in a condition whereby none of the alarm and transfer functions (paragraph 3.4.1.4) exist and shall have no tape movement. The two tape transports shall be interconnected and capable of operation in a sequential manner to provide for operation as described in paragraphs 3.4.1.3 and 3.4.1.4.1. Additionally, the transports shall be capable of individual operation with no interaction whereby one transport can operate and record normally, fully monitored, while the other transport is operating in a test mode in order that required preventive and corrective maintenance can be performed.

3.4.1.1.1 Isolation.- There shall be sufficient isolation between the two tape transports to permit servicing, reloading, and testing one transport without interrupting the operation of the other panel. It shall not be required to remove the transport from the cabinet for servicing.

3.4.1.1.2 Tape-remaining sensor.- Each transport shall be equipped with an adjustable optical tape-remaining sensor, requiring no mechanical contact with the tape. Special leaders or tape modifications shall not be used. The tape remaining sensor shall detect the point (sensing point) at which the original amount of tape on the supply reel has been exhausted to a predetermined level defined in remaining minutes of operation. The sensing point shall be adjustable over a range of 15 to 45 minutes. Operation of the sensor, when the adjusted sensing point is reached, shall start the standby transport as described in paragraph 3.4.1.3

3.4.1.2 Common electronics package.- A common electronics package shall contain all of the recording amplifier circuitry for both transports. It shall contain the record amplifier printed circuit boards, each of which shall provide circuitry for 4 channels which shall be multiplexed to drive 1 track of the 42 tracks which can be recorded.

3.4.1.3 Switching circuitry.- A circuit shall be provided to place the standby transport into operational use automatically when the tape level of the operating transport reaches the adjusted sensing point. The switching circuitry shall provide for parallel operation of both transports for a 1/2 hour overlap period, after the sensing point is reached. The switching circuitry shall provide for transfer of all recording functions to the standby transport upon the occurrence of any of the alarm and transfer functions (paragraph 3.4.1.4.1). The switching circuitry shall not transfer the recording functions in the event of primary a.c. power interruptions. In this case, the time period required for the standby transport to attain normal operating condition, as described herein, shall not exceed 10 seconds maximum with manual intervention required.

3.4.1.4 Automatic system monitor.- An automatic monitor shall be provided to perform the following functions and as described herein. The monitor shall be provided with aural and visual alarm indications as described. The indications shall remain activated until manually reset by a front panel device.

In all cases, the monitoring features shall not transfer to a standby transport until the indications are reset on the alarming transport. After reset, the monitor shall indicate the current status of the operating system.

3.4.1.4.1 Alarm and transfer function.- The following conditions shall activate an aural and visual alarm, activate the standby transport, and transfer all record functions to this transport:

(a) Tape breakage

(b) Supply reel runs out of tape

(c) Failure of the tape remaining sensor

(d) Any condition that applies reel brakes

(e) Failure of both modules, or the common circuitry, of any dual power supply on a transport

(f) A no sync indication

3.4.1.4.2 Alarm functions.- The following conditions shall activate only the aural and visual alarms:

(a) Failure of any power supply module
(b) Loss of digital time code signal recorded on the tape
(c) Oscillator failure or bias driver output loss
(d) Record or reproduce malfunction (track/channel)

3.4.1.5 Channel monitor.- A channel monitor capability shall be provided which will permit manual monitoring of any one of the recorded channels without interrupting normal operation or affecting the continued normal automatic monitoring action. The output of the monitor amplifier shall be connected to a speaker, VU meter, and headset jack. A volume control shall be provided to control the headset and speaker audio output level.

3.4.1.5.1 Speaker.- The impedance of the speaker shall be 8 ohms and shall handle an input signal of not less than 4 watts. The nominal input to the speaker from the amplifier shall be 2 watts.

3.4.1.5.2 Headset jack.- A headset jack equal to JJ-086 or JJ-034 of MIL-J-641G shall be provided with mating headset. The monitor jack shall be of the shorting type and shall be terminated such that the speaker, but not the channel monitoring circuit, shall be disconnected when a headset plug is inserted. The output impedance of the headset jack shall be 600 ohms $\pm$ 20 percent and the nominal input level to the headset one milliwatt.

3.4.1.5.3 VU meter.- A volume unit (VU) meter shall be provided and shall be calibrated to indicate volume levels in the range of -20 to +3 VU, with a reference level of 0 dBm. The meter shall be connected ahead of the speaker and headset volume controls. Provision shall be made for switching the meter into the recording circuits ahead of the record heads.

3.4.1.6 Common connector panel.- The common connector panel shall accept all audio inputs, the digital time code input, maintenance channel input, and remote indicator connectors. The recording system shall be provided with a common connector panel to interface with the input signal leads as required. The connector panel shall consist of multi-pin male Amphenol or Cinch Jones type connectors each of which will accept the matching female input connector cabled from the FAA position equipment for recording operational inputs. Each connector shall provide access to one recording track. Each channel shall be provided with two balanced leads and a ground lead in the connector associated with a track. Two additional connectors shall be provided -- one each for the required maintenance channel input and the coded time input.

3.4.1.6.1 Connections and test jacks.- Each multiplexing track module shall contain on its rear surface one connector for all connections to that module. Additionally, test jacks shall be provided on the front surface of the module which are individually paralleled to the input connectors and permit the introduction of test tones into each of the individual channels superimposed on the normal recording information.

3.4.1.6.2 Remote indicators.- Three leads from isolated sets of contacts of fail safe relays, in either arrangement, shall be brought to connectors on the common connector panel for use with remote indicators. They shall have the indication capability as follows:

(a) No tape/tape break A
(b) No tape/tape break B
(c) Record op/non-op transport A
(d) Record op/non-op transport B
(e) Alarm on/off

3.4.1.7 Power supply system.- The power supply system shall consist of three identical dual power supplies which shall be used to provide power to each of two tape transports and the common electronics package.

3.4.1.7.1 Dual power supply.- A dual power supply shall consist of two modules configured to provide 50 $\pm$ 5 percent of full rated output and have the capability of current division to a load. Each module shall be capable of providing sufficient power to operate either of the two tape transports or the common electronic packages under all operation requirements in the event of one module failure. Switchover to single module operation shall occur automatically without interruption of the recording process. The two modules of each dual power supply shall be mounted side by side in one of the recorder racks. Either module shall have the capability of being removed from service without interfering with the operation of the other module. There shall be sufficient isolation between the dual power supplies such that a short circuit in the output of one supply module shall not disable the other supply module. Each module shall be separately protected and manually controlled with a circuit breaker.

3.4.1.7.1.1 Power supply circuit breakers.- The power supply circuit breaker shall conform to Heineman #HEZ-A8-15-1, or equal.

3.4.1.8 Bias oscillator.- There shall be a dual bias oscillator so that if one fails, the second unit shall immediately supply bias to the appropriate circuitry.

3.4.1.8.1 Bias oscillator switch.- Provisions shall be made to disable the bias and record function in order to use a test tape. This feature shall be provided with a fail safe switch, mounted inside of the cabinet, such that upon switch operation, the reproduce function will continue but all recording capabilities will be disabled.

3.4.2 Record capacity.- Each record system transport shall be capable of recording a minimum of 152 channels continuously for 16.5 hours without a change of tape.

3.4.3 Input levels and frequencies.- The record system shall record, within specification limits, all audio signals with input levels ranging from -15 dBm to +6 dBm without manual adjustment. The input audio signals presented to the recording equipment will contain the full range of natural sounding speech frequencies from 100 Hz to 10,000 Hz. All input levels specified are system input levels.

3.4.4 Input impedance.- The channel input impedance of the common electronics package shall be 600 ohms $\pm$ 10 percent, balanced and isolated from ground.

3.4.5 Frequency response.- At the record speed, when any of the data or voice channels has a signal in the range of 100 Hz to 10,000 Hz at a 0 dBm level applied to its input terminals, with AGC active, and with the record system monitor output adjusted to reproduce a 1,000 Hz reference signal at 0 dBm, the channel frequency response between the record system input and the record system monitor output for frequencies over the range of 300 Hz through 2700 Hz shall not vary more than 6 dB. The frequency response shall continuously decrease with decreasing frequency below 300 Hz to a level not greater than -30 dBm and continuously decrease with increasing frequency above 2,700 Hz to a level not greater than -30 dBm. After reaching the -30 dBm level, the level of frequencies further removed from the passband shall not be greater than -30 dBm.

3.4.6 Harmonic and intermodulation distortion.- When any frequency from 100 Hz to 10,000 Hz is applied to a data or voice channel at a level of +6 dBm, with AGC active, and the record system monitor output adjusted to reproduce a 1,000 Hz reference signal at 0 dBm, there shall be no distortion component that is greater than -34 dBm at the record system monitor output.

3.4.7 Noise.- Using a -15 dBm 1,000 Hz signal at the record system input and a 0 dBm signal at the record system monitor output as a reference, the noise level, when the signal is removed, shall not be greater than -30 dBm at the record system monitor output.

3.4.8 Crosstalk.- When any or all of the data or voice channels, except the channel under test, has a signal in the range of 100 Hz to 10,000 Hz at a 0 dBm level applied to its input terminals, with AGC active, and with the record system monitor output adjusted to reproduce a 1,000 Hz reference

signal at 0dBm for all channels, there shall be no signal component on the channel under test having an output level greater than -30 dBm at the recorder monitor output.

3.4.9 Hum distortion.- The hum distortion produced in each channel when measured at the monitor output shall not be greater than -35 dBm with an input level of -15 dBm at 1,000 Hz to the channel and an output level of 0 dBm at the recorder monitor output.

3.4.10 Record amplifier (AGC).- Each record amplifier channel shall have an automatic gain control (AGC) circuit, which has a dynamic range of 21 dB, which shall provide equalization for the input voltage over a range of -15 dBm to +6 dBm. It shall be possible to disable the AGC for the purposes of maintenance testing. All tests will be made with the AGC activated, unless otherwise specified.

3.4.10.1 Regulation release time.- Level regulation shall be provided so that a 21 dB drop in input level from +6 dBm to -15 dBm shall not result in more than a 3 dB change in record level. The output level shall be within + 0.5 dB of the final steady state value within the adjustable range of 80 - 240 milliseconds from the instant of the input level change.

3.4.10.2 Regulation attack time.- At the conclusion of 3.4.10.1 with a sudden increase in the input signal level from -15 dBm to +6 dBm, the output level shall stabilize to within ±2 dB of the final steady state value in not more than 10 milliseconds from the instant of input level change.

3.4.11 Test fixture interconnection.- A semiautomatic device shall be provided for each record system transport whereby signals to and from the test fixture may be injected into or recovered from any one of the 40 tracks by manual selection. This device must be readily accessible from the front of the cabinet.

3.5 Reproduce system.- The requirements of this paragraph and its subparagraphs shall apply to the reproduce system. The reproduce system shall be capable of reproducing simultaneously any 2 of the 152 channels recorded on a 1-inch tape. The reproduce system shall be cabinet mounted, and shall have no provision for recording or erasing magnetic tape, except in the tape copier also provided.

3.5.1 Frequency response.- At the play speed, using the test tape, and a 1,000 Hz signal at 0 dBm at the reproduce system monitor output as reference, the channel frequency response of the reproduce system monitor output for frequencies between 300 and 2,700 Hz shall not vary more than 6 dB. The frequency response shall continuously decrease with decreasing frequency below 300 Hz to a level not to exceed -30 dBm and continuously decrease with increasing frequency above 2,700 Hz to a level not to exceed -30 dBm. After reaching the -30 dBm level, the level of frequencies further removed from the passband shall not be greater than -30 dBm.

3.5.2 Harmonic and intermodulation distortion.- When any frequency from 100 Hz to 10,000 Hz has been applied from the test tape at a level of +6 dBm and the reproducer monitor output adjusted to reproduce a 1,000 Hz

reference signal at 0 dBm, there shall be no distortion component that is greater than -34 dBm at the reproducer monitor output.

3.5.3 Noise.- Using a 1,000 Hz signal, recorded on the test tape at a level of -15 dBm and 0 dBm at the monitor output as a reference, the noise level, when the signal is removed, shall not be greater than -30 dBm at the reproduce system monitor output.

3.5.4 Crosstalk.- When any or all of the data or voice channels, except the channel under test, has a signal in the range of 100 Hz to 10,000 Hz at a 0 dBm level applied from the test tape, and with the reproducer monitor output at 0 dBm for all channels, there shall be no signal component on the channel under test having an output level greater than -30 dBm at the reproduce system monitor output.

3.5.5 Hum distortion.- The hum distortion produced in each channel, when measured at the monitor output, shall not exceed -35 dBm with an input level of -15 dBm at 1,000 Hz to the channel and an output level of 0 dBm at the reproduce system monitor output.

3.5.6 Bidirectional operation.- The reproduce system transport shall be capable of automatic time search (paragraph 3.5.9.2) during bidirectional operation.

3.5.7 Play speed.- The play speed of the reproduce system shall correspond to the record speed of the record system within an accuracy of 0.15 percent. The accuracy measurement shall be made in accordance with IRIG-118-73, paragraph 5.2.2.2.2.

3.5.8 Fast forward and rewind speeds.- The reproduce system transport shall operate at 100 and 10 times normal play speed in both forward and rewind direction under servo control. The recording tape shall not contact any heads under these conditions. It shall be possible to change the direction of the tape movement without damage to the tape, or any manual handling of the tape.

3.5.9 Tape search.- Tape search shall be accomplished in accordance with the following subparagraphs:

3.5.9.1 Tape search - manual.- Provisions shall be made to permit a manual forward and reverse search operation. Coded time read-out shall be provided during the manual search. Controls shall be incorporated to permit the operator to move the tape in forward and reverse directions at a rate of 8 to 10 times the play speed in addition to normal speed.

3.5.9.1.1 Remote control.- Foot operated remote control for play forward, slow reverse, and stop modes shall be provided.

3.5.9.2 Tape search - automatic.- The reproduce system shall be capable of automatic time search using the recorded time code after a preset time has been selected by the setting of a time code selector. Speed of the tape movement in this mode shall be at the rate of 100 (+5 percent) times the play speed.

3.5.9.2.1 Stop distances.- At the search speed, 100 times the play speed, the tape shall stop in a distance corresponding to not more than 4.5 minutes of recorded time, at any point on the tape after receiving the stop command.

3.5.9.2.2 Reader search unit.- One track (no. 41) shall terminate in a reader search unit which has the capability of controlling the transport in the forward or reverse search modes of operation. The reader search unit is intended to be an off-the-shelf item requiring little or no modification.

3.5.9.2.3 Time code.- The reader search unit shall respond to the time code, modified IRIG E, recorded on the corresponding track by the record system when produced by a time code generator conforming to the requirements of Specification FAA-E-2306, Amendment-1, Specification Change 1 and Specification Change 2, at the normal record speed and the tape search speeds (paragraph 3.5.8).

3.5.9.2.4 Time code read-out.- A numerical time code read-out shall be provided indicating the coded time on the tape in hours, minutes, and seconds. The read-out device shall be of the long-life, wide-angle type having a numerical display with a height of 0.6 inch.

3.5.10 Channel monitor.- Provisions shall be made to select and playback any of the 152 channels. The selectable channels shall include any of the data or voice channels, either singly or in pairs.

3.5.10.1 Channel selection.- Switches indicating the channels selected for playback shall be provided. Each channel shall be selected by means of two sets of switches. One set shall select the track and the other set shall select one of four channels on the track.

3.5.10.2 Channel monitor terminations.- The dual channel monitor system shall have facilities to terminate in a stereo headset, dual speakers, and a dual channel tape copier.

3.5.10.2.1 Headset termination.- Both headset channels shall terminate in a jack circuit equipped with volume controls and have a nominal output impedance of 600 ohms $\pm$ 20 percent. A matching stereo headset shall be provided. The input level to each headphone shall be one milliwatt.

3.5.10.2.2 Speaker termination.- Each speaker channel shall terminate in a separate speaker equipped with a volume control. The speakers shall be automatically disabled when the headset jack is in use. The nominal input level shall be 2 watts into an 8 ohm speaker.

3.5.11 Tape copier.- The tape copier with a selectable connection to the time code reader and two speakers shall be mounted in a portable carrying case and housed in the reproduce system cabinet. The tape copier shall record and reproduce the channels, selected by the channel monitor. The requirements of the following subparagraphs shall apply to the tape copier. The tape copier is intended to be an off-the-shelf item requiring little or no modification.

3.5.11.1 Construction.- The tape copier with a selectable connection to the time code reader and two speakers shall be mounted in a portable carrying case and housed in the reproduce system cabinet. When the tape copier is in the reproduce system cabinet and with the carrying case lid removed, the front of the tape copier shall lie in the same plane as the front of the reproduce system. The tape copier shall be readily removable from the cabinet and all connections to the tape copier shall be a quick-disconnect type.

3.5.11.2 Frequency response.- At the record speed the frequency response of each channel shall be ±2 dB between 100 Hz and 7 kHz.

3.5.11.3 Crosstalk.- The crosstalk in each channel shall be not less than 35 dB below the channel signal level.

3.5.11.4 Noise.- The noise in each channel shall be not less than 50 dB below the channel signal level.

3.5.11.5 Harmonic distortion.- The total harmonic distortion of each channel shall not exceed 3 percent at a frequency of 600 Hz.

3.5.11.6 Hum distortion.- The hum distortion produced in each channel shall be not less than 35 dB below the channel signal level.

3.5.11.7 Tape.- The tape copier shall operate with 1/4-inch wide, 1 mil or 1-1/2 mil thick acetage or polyester backed tape.

3.5.11.8 Play speed.- Tape speed shall be 1-7/8, 3-3/4, 7-1/2 ± 2.0 percent inches per second with a.c. power of 120 V a.c. 60 Hz. There shall be no 60 Hz oscillator built into the tape speed mechanism.

3.5.11.9 Flutter.- When measured using the ASA standard audio weighting curve, flutter shall not exceed 0.17 percent rms.

3.5.11.10 Rewind operation.- The tape copier shall be capable of rewinding 1,200 feet of tape in 90 seconds or less.

3.5.11.11 Record monitor.- The tape copier shall be capable of reproducing while recording.

3.5.11.12 Meters.- Individual VU meters shall indicate the audio input level to each copier recording channel.

3.5.12 Auxiliary output.- Provisions shall be made to use an external magnetic tape recorder/reproducer in the event of a failure of the tape copier.

3.5.13 Audio filter.- A variable bandpass audio filter may be provided. It shall be possible to switch this filter into the output of any data channel. The filter shall consist of a low pass section and a high pass section in tandem. The -3 dB cutoff frequency of the high pass section shall be variable over a minimum range of at least 150 Hz to 1,500 Hz. The -3 dB cutoff frequency of the low pass section shall be variable over a minimum range of at least 1 kHz to 5 kHz. The bandpass insertion loss of

each filter section shall be 0 db ± 0.5 dB. Each filter section shall have a nominal 18 dB per octave slope in the cutoff region. The filter shall not degrade the signal-to-noise ratio or distortion of the channel in which it is inserted beyond the limits specified for the reproduce system. The audio filter is intended to be an off-the-shelf item requiring little or no modification.

3.6 Tape degausser unit.- The requirements of this paragraph and its subparagraphs shall apply to the degausser unit. The tape degausser may be provided and shall be capable of complete automatic degaussing of instrumentation, video, audio, and computer tapes without unwinding the tape.

3.6.1 Tape conditioning.- The degausser unit shall recondition the tapes to the extent of reducing recorded signals to a level of 85 dB below magnetic saturation.

3.6.2 Tape reels.- The degausser unit shall accept tape reels having a maximum diameter of 15-inch and 1-inch thickness. The unit shall accept all tape reels usable on either the high capacity voice recorder or the tape copier.

3.6.3 Automatic operation.- The operator shall not be required to hand rotate the reels of tape, turn them over while in the degausser, or withdraw the tape by hand from the magnetic field.

3.6.4 Degausser cycle.- The start of the degausser cycle shall be by single actuation of a switch. The total degaussing time shall not exceed 50 seconds. The end of the automatic degausser cycle shall be indicated by an indicator lamp.

3.6.5 Power requirement.- Input power requirements shall be 105 to 125 volts 57 Hz to 63 Hz. The maximum current drawn under any operating condition shall not exceed 25 amperes. A blower system for cooling the degausser unit shall operate with power "on" and continue to operate until power "off".

3.6.6 Physical characteristic.- The degausser unit shall not exceed 13 inches high, 19 inches wide, and 23 inches deep.

3.6.7 Dolly. - The degausser unit shall be provided a dolly 24 inches high upon which to rest the tape degausser. No attachment device(s) such as screws or bolts will be required to fasten or remove the tape degausser upon the dolly.

3.7 Test fixture.- A test fixture shall be furnished with each record system. The test fixture shall be capable of checking the operation of a complete module or submodule primarily for troubleshooting purposes. The text fixture shall include the following items:

(a) One record multiplexing track module (so that test tones can be injected individually into each channel of the non-operating transport).

(b) One demultiplexing module.

(c) One each of all other electronic modules used in the system.

(d) One of each type of extender cards or cables (if extender cards are identical, two shall be provided).

(e) One power supply (for supplying the proper power for all cards or modules).

3.8 Construction.- Construction of the equipment shall have a high degree of standardization with regard to cabinets, modular packaging, module holders, printed circuit cards, parts, materials, processes, and workmanship. The system shall be expandable to the design capabilities by the insertion of modules or printed circuit cards. All identical items shall be interchangeable. The system shall conform to the requirements of FAA-G-2100/1b, /3a, /4b, and /5.

3.8.1 Cabinets.- Cabinets shall be furnished for mounting the record-reproduce system. Each cabinet shall not exceed 23 inches in overall width, 24 inches in overall depth, and 83 inches in overall height. Cabinets may be constructed in accordance with MINCOM drawing 32028A501 or equal and shall meet the intent of Specification FAA-E-163b, Amendment 2 and Change 3.

3.8.1.1 Record system cabinets.- The record system shall not require more than three cabinets. The cabinets shall have the provision for bolting permanently to the floor. Floor loading shall not exceed 200 pounds per square foot. All cabinets shall be prewired.

3.8.1.2 Reproduce system cabinet.- The reproduce system cabinet design shall provide for manual transportability between areas in a building. Two spring retracted metal handles shall be provided at each end of the cabinet. The cabinet shall be mounted on rubber-tired swivel wheels with a minimum diameter of 5 inches. It shall be capable of being lifted by forklift in order to be moved from one site to another.

3.8.1.3 Cooling.- Cabinet cooling design shall be such that cooling remains adequate with air flow blocked externally on any two sides of the cabinet.

3.8.2 Acoustic noise.- The noise level shall not exceed the limits given in MIL-STD-1472A, Figure 33, NC Curve 60.

3.8.3 Accessibility.- Front access and plug-in module features shall be used throughout. Switchable meters shall be provided for voltages and currents which are frequently monitored. All overload protective devices shall be front located for quick access and shall have circuit identification and a status lamp.

3.8.4 Modular expansion.- The channel capacity of the recorder shall be capable of adjustment up to full capacity by the addition of track modules without interrupting service. Each track module shall contain all the necessary electronics to record all channels related to that particular track. All track modules shall use a common position on the connectors for the power supply and ground leads. All identical track modules shall be

interchangeable. All identical channel submodules shall be interchangeable. Screwdriver adjustments required for alignment shall be held to an absolute minimum and, where required, shall be mounted in accessible locations on the module or submodule with which they are associated.

3.8.4.1 Module isolation.- All equipment shall be designed to enable the removal and return of track modules and submodules without generating logic or electronic disturbances that might affect on-line system operation.

3.8.4.2 Module identification.- All modules and submodules shall be marked in accordance with paragraph 1.3.12 of FAA-G-2100/1b for ease of identification and they shall have serial numbers. Modules and submodules shall be mechanically keyed to prevent insertion of similar, but incompatible, circuit elements. The number of different types of modules and submodules shall be held to a minimum.

3.8.4.3 Submodules.- All submodules shall use a common position of the connectors for common power supply and ground leads.

3.8.5 Integrated circuits.- Integrated circuits used shall meet the requirements of FAA-G-2100/5.

3.8.6 Cables.- The contractor shall furnish all cables, with cable connectors, required for factory test, installation checkout, and operation, and any special purpose cables required for routine maintenance. Where patch panels or plug boards are used in the equipment, the contractor shall provide adequate plug and patch cables required for normal equipment operation.

3.8.6.1 Power cables.- A.C. supply line cabling (120 V/240 V 60 Hz) in rack cabinets, equipment cabinets, and other facilities similar to these enclosures or external thereto, may employ Underwriters' approved power and lighting wire and cable. This shall not apply to wiring within panel chassis and similar equipment assemblies. In applications where electromagnetic interference requirements are imposed, shielded twisted pairs conforming to the requirements of paragraph 1-3.10.1.2 of FAA-G-2100/1b with Supplement 4 and Amendment 1 may be used throughout the equipment (rack, chassis, and panel wiring). If shielded a.c. supply cable is used, the conductors shall be color coded in accordance with the National Electric Code as required by paragraph 1-3.6.6 of FAA-G-2100/1b.

3.8.6.2 Audio cables.- All audio cables shall be shielded.

3.8.7 Chassis equipment.- Power supply and regulation equipment shall be mounted on front access drawer assemblies with the heaviest items in the lower part of the cabinet. Panel mounted meters shall indicate the magnitude of the supply voltages and currents.

3.8.8 Alignment tools and test equipment.- Specially designed test equipment shall not be required except for the test fixture under paragraph 3.7.

3.8.8.1.- The contractor shall furnish a list of currently available test equipment necessary to maintain the system.

3.8.8.2.- The contractor shall furnish a list of any special alignment tools, including a tape track certifying kit, used for troubleshooting and aligning the tape path components.

3.8.9 Panel lay-out sketches.- Lay-out sketches drawn to scale, showing the arrangement of controls, indicating devices, and markings on each of the front panels comprising the record system and the reproduce system shall be submitted for Government approval prior to initiation of construction.

3.8.10 Metal surfaces.- All metal surfaces shall be treated to resist corrosive action. Outside surfaces shall be painted in accordance with FAA-STD-012a.

3.8.11 Service life.- The system shall have a minimum service life of 15 years, operating 24 hours per day and 7 days per week.

3.8.12 Interference.- The system shall not interfere with other FAA electronic equipment nor be susceptible to any environmental disturbances which cause an undesired response, malfunction, or degradation of performance. The equipment shall be designed to meet the following tests of MIL-STD-461:

CE 03: Power load conducted emission, 20 kHz to 50 MHz

CE 04: Signal lead conducted emission, 20 kHz to 50 MHz

RE 02: (As modified herein) Radiated E field emission, 14 kHz to 1 MHz

3.8.13 Warmup time.- The equipment shall operate within specification limits after warmup time of 1 minute when the equipment ambient temperature is at the normal operating conditions (paragraph 3.2.1) and after a warmup of 5 minutes when the equipment ambient temperature and humidity are at all other levels of service conditions (paragraph 3.2.2).

3.8.14 Environmental conditions.- The equipment shall be designed to operate under the following environmental conditions.

Elevation:	0 to 10,000 feet above sea level
Duty:	continuous unattended
Temperature:	$+10^{o}$ C to $+50^{o}$ C
Relative humidity:	10 percent to 80 percent
AC line voltage:	105 to 130V
AC line frequency:	60 $\pm$ 3 Hz

3.9 Reliability and maintainability.- A reliability and maintainability program shall be implemented in accordance with MIL-STD-785A and MIL-STD-470. The tasks and program documentation are covered in the subparagraphs herein. The record and reproduce systems shall be designed with the reliability and maintainability requirements specified herein in accordance with the following paragraphs.

3.9.1 Reliability program plan.- A reliability program plan in accordance with MIL-STD-785A and FAA-E-2100/1b, Amendment 2 shall be submitted to the government within 45 days after receipt of contract.

3.9.1.1 Reliability prediction report.- A reliability prediction report shall be available at the preliminary design review for review and comment. This report shall be prepared in two parts, consisting of Part I, the record system transport and associated electronics; and Part II, the reproduce system transport and associated electronics. All definitions shall agree with MIL-STD-721. Reliability prediction shall be based on MIL-HDBK-217A and shall contain information in accordance with Section 5, "How to Make a Reliability Prediction Based on Stress Factors and Parts Population," and Section 7, "Failure Rates." All failure rate data shall be presented in module failure per 10^6 hours. All predictions shall be based on environmental temperature conditions at 30^0 C. Particular consideration should be given to thermal design aspects as contained in Section 6, "General Equipment and Part Application Considerations". Parts not included in the coverage of MIL-HDBK-217A shall be assumed to possess the failure rate of the most similar part in the coverage. Where this is unrealistic, any valid existing data may be used, subject to Government acceptance.

3.9.1.1.1.- An updated reliability prediction report shall be submitted as the design changes, but no later than previous to acceptance testing/reliability testing of equipment hardware.

3.9.1.2 Parts control (selection and application).- The contractor shall use parts selected from and supplied as specified in FAA-G-2100/1b. Parts not meeting requirements of FAA-G-2100/1b are non-standard parts which require action as outlined in paragraph 5.2.3 of MIL-STD-785A. Failure rate levels shall be provided by the contractor with justification for all parts including non-standard parts not covered by MIL-HDBK-217A.

3.9.1.3 Record system mean time between failure

(a) On a system basis, the loss of recording capability on all channels, for as long as 5 minutes, shall not occur more frequently than once in 5 years.

(b) The loss of recording capability on a channel for a period greater than 10 seconds, shall not occur more frequently than once in 30,000 hours.

(c) For the overall recording system a failure requiring a corrective maintenance action of any type shall not occur more frequently than once in 200 hours.

3.9.1.4 Reproduce system mean time between failure

(a) On a system basis, the loss of all reproduce capability, for as long as 5 minutes, shall not occur more frequently than once in 5 years.

(b) The loss of reproduce capability on a channel for a period greater than 10 seconds shall not occur more frequently than once in 60,000 hours.

(c) For the overall reproduce system a failure requiring a corrective maintenance action of any type shall not occur more frequently than once in 20,000 hours.

3.9.1.5 Reliability demonstration test plan and procedure.- A reliability demonstration test plan and procedure delineating a reliability demonstration test in detail, shall be submitted for approval prior to conducting a demonstrated test. The test plans contained in MIL-STD-781 shall be applied, when applicable. Any other reliability test plans proposed shall be detailed with regard to sample size, duration of test confidence level, conditions of test, and accept/reject criteria, etc.

3.9.1.5.1.- For purposes of the reliability demonstration testing, a relevant failure is an unpredictable occurrence wherein the equipment under test failed to perform its required function within previously established limits, or any condition that produces an alarm, or any malfunction whatsoever.

3.9.1.5.2 Multiple failures.- In the event two or more part failures are detected in the equipment being tested and one or more of these part failures are the primary cause of the test malfunction, each failed part which will independently prevent satisfactory equipment performance is considered a failure, except as follows: If it is determined that the failure of one part was responsible for the failure of another part then each secondary part failure is not counted as an equipment failure when the accept/reject criteria is applied.

3.9.1.5.3 Non-Relevant failures.- Failures classified as non-relevant are identified below. Failures identified as non-relevant will be subject to review by FAA.

3.9.1.5.3.1 Failures caused by external sources.- All failures caused by sources external to the equipment under test will be considered non-relevant. This includes failures caused by operator error, test equipment malfunction, and test facility malfunction.

3.9.1.5.3.2 Secondary failure.- A secondary failure is the failure of a part which is a direct result of a primary failure. Secondary failures are not necessarily present when simultaneous failures occur. Secondary failures will be considered non-relevant.

3.9.1.5.4 Analysis of failures.- All equipment failures will be analyzed. The objective is to provide a critical examination of all failures and failure modes to determine the cause and recommend corrective action to reduce causes of unreliability. Failures will be reviewed at the equipment level to assure proper part application (i.e., thermal, electrical overstress, and mechanical stresses as possible cause of failure). Failures will be analyzed at the component/part level. Analyses will include verification, laboratory analyses, teardown, dissection, and x-ray, as required.

3.9.1.6 Reliability conditioning test plan.- An approved reliability conditioning (assurance) test plan shall be submitted for the reliability conditioning test indicated in paragraph 4 herein.

3.9.2 Maintainability program plan.- A maintainability program plan in accordance with MIL-STD-470 and FAA-E-2100/1B, Amendment 2, shall be submitted to the government within 45 days after receipt of contract.

3.9.2.1 Maintainability prediction report.- A maintainability prediction report shall be prepared in accordance with MIL-HDBK-472, Procedure II.

3.9.2.2 Maintainability design criteria.- The contractor shall establish and periodically update a detailed maintainability design criteria determined from the repetitive system/equipment maintainability analysis. Appropriate consideration of maintainability design criteria shall be reflected in design concept reviews, item selection, design reviews, and trade-offs.

3.9.2.2.1 Corrective maintenance.- In the event of a failure, it shall be possible to restore the electronic equipment to an operational condition within 5 minutes. This time is based on removing and replacing the failed module with a like module or circuit card.

3.9.2.2.2 Preventive maintenance.- Preventive maintenance schedules shall be provided. Particular consideration shall be given to those parts that exhibit an increased failure rate with time. The parts selected for use in the equipments shall exhibit a very high reliability to preclude the necessity of an excessive or time-consuming preventive maintenance schedule.

3.9.2.3 Maintainability demonstration plan.- The contractor shall prepare and submit a maintainability demonstration plan. The demonstration will be accomplished in accordance with MIL-STD-471 and will verify the achievement of the maintainability requirements by the hardware design.

3.9.3 Preliminary design review.- The contractor shall hold a preliminary design review with representatives of the government present prior to the fabrication of any equipment. The preliminary design review shall include the configuration of all chassis and panels, preliminary reliability prediction report, and preliminary maintainability design criteria. An electron device complement report shall be submitted and include all semiconductor devices to be used in the equipment with full operating data at 0^{o} C, at 25^{o} C, and at 50^{o} C.

3.10 Accessory equipment.- The following equipment shall be furnished in quantities specified in the contract:

3.10.1 Test tape.- A test tape shall be provided with each system which shall contain an alignment section and sufficient data with voice channel identification and time channel correlation to evaluate system compliance with the following parameters as specified herein in every channel:

(a)	Harmonic distortion	paragraph 3.4.6 and 3.5.2
(b)	hum distortion	paragraph 3.4.9 and 3.5.5
(c)	frequency distortion	paragraph 3.4.6 and 3.5.1
(d)	WOW and flutter	paragraph 3.3.6
(e)	crosstalk	paragraph 3.4.8 and 3.5.4

Each tape shall be supplied with a level calibration chart and time listings.

3.10.1.1 Verification of test tape.- All test tapes shall be recorded on a master recorder in order that all test tape parameters are essentially the same. Each test tape shall be verified on its associated recorder with respect to meeting the requirements of paragraph 3.10.1 above prior to acceptance.

3.10.1.2 Adjustments.- No mechanical adjustments are to be made with this test tape.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- The contractor shall provide and maintain a quality control program which fulfills the intent of FAA-STD-013a Quality Control Program requirement and FAA-G-2100/1b, Supplement 4 and Amendment 2, Section 1-4, and its subparagraphs.

Unless another person or organization is so designated, the Chief Industrial Division, ALG-400, Logistics Service, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591, is the agency office responsible for determining the adequacy of the contractor's quality, reliability, and inspection programs and for accepting the material, equipment, and services. He will assign a Quality and Reliability Officer (QRO) to inspect, test, and accept or reject the required material, equipment, or services in accordance with the terms of the contract. The QRO assigned to your plant is delegated the authority to approve minor deviations which do not affect contract price, delivery, or equipment performance and is delegated the sole authority to accept or reject material, equipment, and services in-plant in accordance with the terms of the contract.

In addition, QROs perform in-plant contract administration functions such as: monitoring production progress, expediting delivery, evaluating proposed technical changes to the equipment, reviewing instruction books, requests for progress payments, and investigating specific problems. To facilitate timely consideration of those things which affect contract performance, it is essential that the contractor furnish the QRO with a copy of the contractor's monthly production progress reports, PERT networks in accordance with FAA-STD-007 (if required), requests for technical changes to specification requirements, and general correspondence which is pertinent to timely contract performance and delivery of the items required by the contract.

4.2 Design qualification tests.- The tests as defined herein shall apply to the first production equipment only.

4.2.1 Service conditions.- The following test shall be made while subjecting the equipment to the test procedures described under paragraph 1-4.12 of FAA-G-2100/1b, Supplement 4 and Amendment 2. All power supplies may be tested independently of the systems equipment under the referenced service conditions and at power inputs of 105, 120, and 130 V AC. Provided the results of the power supply tests confirm a variation in output voltage within ±1 percent of nominal under all power input and environmental requirements, each of the following tests may then be conducted at 120 V AC power input.

4.2.1.1 Record system

Paragraph	Definition of test	Channel tested, where applicable
3.4.1.4	Automatic monitor	(All tracks)
3.4.1.5.1	Speaker	
3.4.3	Input levels	(All channels)
4.5	Thermal design tests	

4.2.1.2 Reproduce system

Paragraph	Definition of test	Channel tested, where applicable
3.5.8	Fast forward and rewind	
3.5.9.2.3	Time code reader	
3.5.9.2.4	Time code readout	(Not applicable)
3.5.13	Audio filter	
4.5	Thermal design tests	

4.2.2 Normal test conditions.- The following design qualification tests shall be made under normal test conditions:

4.2.2.1 Record system

Paragraph	Definition of test	Channel tested, where applicable
3.3.2	Tape reels	
3.3.3	Tape	
3.3.7	Dynamic skew	
3.3.8	Head alignment	
3.3.12	Head polarity	
3.4.1.1	Dual transports	
3.4.1.2	Common electronics package	
3.4.1.5	Channel monitor	(All channels)
3.4.1.5.2	Headset jack	
3.4.1.5.3	VU meter	
3.4.1.6	Common connector panel	
3.4.1.6.2	Tape break remote indication	
3.4.1.7	Power supply system	
3.4.2	Record capacity	
3.4.4	Input impedance	
3.4.10.1	Regulation release time	(All channels)
3.4.10.2	Regulation attack	
3.8.2	Acoustic noise	
3.8.4.1	Module isolation	
3.8.12	Interference	

4.2.2.2 Reproduce system

Paragraph	Definition of test	Channel tested, where applicable
3.3.2	Tape reels	
3.3.3	Tape	
3.3.7	Dynamic skew	
3.3.8	Head alignment	
3.3.12	Head polarity	
3.5	Reproducer	
3.5.6	Bidirectional operation	(Not applicable)
3.5.9.1	Tape search manual	
3.5.10.1	Channel selection	
3.5.10.2	Channel monitor	
3.5.10.2.1	Headset termination	
3.5.10.2.2	Speaker termination	
3.5.12	Auxiliary output	
3.8.2	Acoustic noise	
3.8.12	Interference	

4.2.2.3 Tape copier

Paragraph	Definition of test	Channel tested, where applicable
3.5.11	Tape copier	
3.5.11.1	Construction	
3.5.11.7	Tape	
3.5.11.8	Play speed	(Not applicable)
3.5.11.10	Rewind operation	
3.5.11.11	Record monitor	
3.5.11.12	Meters	
3.8.12	Interference	

4.2.2.4 Tape degausser

Paragraph	Definition of test	Channel tested, where applicable
3.6	Tape degausser unit	
3.6.1	Tape conditioning	
3.6.2	Tape reels	(Not applicable)
3.6.3	Automatic operation	
3.6.5	Power requirement	

4.2.2.5 Test fixture

Paragraph	Definition of test	Channel tested, where applicable
3.7	Test fixture	(Not applicable)

4.3 Type tests

4.3.1 Service conditions.- The following tests shall be made while subjecting the equipment to the test procedures prescribed under 1-4.12 of FAA-G-2100/1b, Supplement 4, Amendment 2. All power supplies may be tested independently of the systems equipment under the referenced service conditions and at power inputs of 105, 120, and 130 V AC. Provided the results of the power supply tests confirm a variation in output voltage within ± 1 percent of nominal under all power input and environmental requirements, each of the following tests may then be conducted at 120 V AC power input.

4.3.1.1 Record system

Paragraph	Definition of test	Channel tested, where applicable
3.1.1.1	Digital time code track	
3.3.5	Braking system	
3.3.6	Flutter	
3.3.9	Tape speed accuracy	
3.3.10	Start time	
3.4.1.3	Switching circuitry	
3.4.1.7.1	Dual power supply	
3.4.5	Frequency response	One channel per track
3.4.6	Harmonic distortion	One channel per track
3.4.7	Noise	One channel per track
3.4.8	Crosstalk	All channels
3.4.9	Hum distortion	One channel per track

4.3.1.2 Reproduce system

Paragraph	Definition of test	Channel tested, where applicable
3.5.1	Frequency response	One channel per track
3.5.2	Harmonic distortion	One channel per track
3.5.3	Noise	One channel per track
3.5.4	Crosstalk	All channels
3.5.5	Hum distortion	
3.5.7	Play speed	
3.5.9.1	Tape search - manual	
3.5.9.2	Tape search - automatic	

4.3.2 Normal test conditions.- The following tests shall be made under normal test conditions as per paragraph 3.2.1.

4.3.2.1 Reproduce system

Paragraph	Definition of test	Channel tested, where applicable
3.5.9.1	Tape search - manual	
3.5.9.2.1	Stop distances	

4.3.2.2 Tape copier

Paragraph	Definition of test	Channel tested, where applicable
3.5.11.2	Frequency response	
3.5.11.5	Harmonic distortion	
3.5.11.6	Hum distortion	

4.4 Production test

4.4.1 Normal test conditions.- The following test shall be made under normal test conditions as per paragraph 3.2.1. Duplicate testing to verify conformance in both type tests and production tests is not required.

4.4.1.1 Record system

Paragraph	Definition of test	Channel tested, where applicable
3.3.4	End of tape and broken tape sensor	
3.3.5	Braking system	
3.3.6	Flutter	
3.3.10	Start time	
3.3.11	Stop time	
3.4.1.1.2	Tape-remaining sensor	
3.4.1.3	Switching circuitry	
3.4.1.4	Automatic monitor	(All tracks)
3.4.1.5.1	Speaker	
3.4.1.5.2	Headset jack	
3.4.1.7.1	Dual power supply	
3.4.3	Input levels	One channel per track
3.4.6	Harmonic distortion	Four channels at random
3.4.7	Noise	One channel per track
3.4.8	Crosstalk	All channels
4.7	Reliability conditioning	

4.4.1.2 Reproduce system

Paragraph	Definition of test	Channel tested, where applicable
3.3.4	End of tape and broken tape sensor	
3.3.5	Braking system	
3.3.6	Flutter	
3.3.10	Start time	
3.3.11	Stop time	
3.5.3	Noise	One channel per track
3.5.4	Crosstalk	All channels
3.5.9.1.1	Remote control	
3.5.9.2	Tape search - automatic	
3.5.9.2.3	Time code	
3.5.9.2.4	Time code readout	
3.5.10	Channel monitor	
3.5.10.2.1	Headset termination	

Paragraph	Definition of test	Channel tested, where applicable
3.5.10.2.2	Speaker termination	(Not applicable)
4.7	Reliability conditioning	

4.4.1.3 Tape copier

Paragraph	Definition of test	Channel tested, where applicable
3.5.11.3	Crosstalk	
3.5.11.4	Noise	(Not applicable)
3.5.11.9	Flutter	
4.7	Reliability conditioning	

4.4.1.4 Tape degausser

Paragraph	Definition of test	Channel tested, where applicable
3.6.4	Degausser cycle	(Not applicable)
4.7	Reliability conditioning	

4.5 Thermal design tests.- The contractor shall perform a thermal design test on the equipment to verify that no hot spots exist and that the component temperature data used for the reliability prediction is accurate. This test shall be conducted under environment conditions of 50^{o} C and 80 percent relative humidity simultaneously with the service conditions (temperature and humidity) of the design qualification test. The FAA Technical Representative shall determine where thermocouples will be placed on the equipment for this test prior to beginning the type test.

4.6 Reliability and/or maintainability demonstration tests.- A formal reliability and/or maintainability demonstration test shall be conducted by the contractor as specifically prescribed in the approved test plans indicated in paragraph 3.9.1.6 and 3.9.2.3. Demonstration tests shall be made on regular production equipment including those subjected to type and production tests. Successful completion of all demonstration tests shall be accomplished prior to release of production units for shipment.

4.7 Reliability conditioning test.- Each equipment shall be operated under specified normal operating conditions, for 100 continuous failure-free hours in order to eliminate early failures and to age and stabilize the equipment prior to delivery.

4.8 Maintenance records.- During pretest debugging, reliability conditioning, and facility tests, a complete maintenance log which lists malfunctions, their location in the system, and how they are repaired shall be kept. Three copies of this record shall be furnished to the Government at the completion of each test.

5. PREPARATION FOR DELIVERY

5.1 General.- The contractor shall package, ship, and deliver the equipment in accordance with MIL-E-17555G, Level "A".

6. NOTES

6.1 Note on information items.- The contents of this section are only for the information of the initiator of the procurement request and are not a part of the requirements of this specification. They are not contract requirements or binding on either the Government or the contractor. In order for these terms to become a part of the resulting contract they must be specifically incorporated into the schedule of the contract. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk.

6.2 Intended use.- The equipments are to be used in air route traffic control centers and large air traffic control towers to record and reproduce voice transmissions for training and for accident and incident analysis.

* * * * *

APPENDIX

TABLE OF CONTENTS

			Page No.
Section 1.		SCOPE	1
	1.1	Scope	1
Section 2.		APPLICABLE DOCUMENTS	1
	2.1	FAA documents	1
	2.1.1	FAA specifications	1
	2.1.2	FAA standards	2
	2.2	Military and Federal publications	2
	2.2.1	Military specifications	2
	2.2.2	Military standards	2
	2.2.3	Military handbook	3
	2.2.4	Federal specifications	3
	2.3	Other specifications	3
Section 3.		REQUIREMENTS	3
	3.1	Equipment to be furnished by the contractor	3
	3.1.1	Time code generator	4
	3.1.2	Audio filter	4
	3.1.3	Tape degausser unit	4
	3.2	Definitions	4
	3.2.1	Normal test conditions	4
	3.2.2	Service conditions	4
	3.2.3	Channel	5
	3.2.4	Hum distortion frequency	5
	3.2.5	Tape track	5
	3.3	Record and reproduce transport requirements	5
	3.3.1	Transport design	5
	3.3.2	Tape reels	5
	3.3.3	Tape	5
	3.3.4	End-of-tape and broken tape sensor	6
	3.3.5	Braking system	6
	3.3.6	Flutter	6
	3.3.7	Dynamic skew	6
	3.3.8	Head alignment	6
	3.3.9	Tape speed accuracy	6
	3.3.10	Start time	6
	3.3.11	Stop time	6
	3.3.12	Head polarity	6
	3.4	Record system	6
	3.4.1	Record system	6
	3.4.2	Record capacity	10
	3.4.3	Input levels and frequencies	10
	3.4.4	Input impedance	10
	3.4.5	Frequency response	10
	3.4.6	Harmonic and intermodulation distortion	10
	3.4.7	Noise	10
	3.4.8	Crosstalk	10

TABLE OF CONTENTS (cont'd)

		Page No.
3.4.9	Hum distortion	11
3.4.10	Record amplifier (AGC)	11
3.4.11	Test fixture interconnection	11
3.5	Reproduce system	11
3.5.1	Frequency response	11
3.5.2	Harmonic and intermodulation distortion	11
3.5.3	Noise	12
3.5.4	Crosstalk	12
3.5.5	Hum distortion	12
3.5.6	Bidirectional operation	12
3.5.7	Play speed	12
3.5.8	Fast forward and rewind speeds	12
3.5.9	Tape search	12
3.5.10	Channel monitor	13
3.5.11	Tape copier	13
3.5.12	Auxiliary output	14
3.5.13	Audio filter	14
3.6	Tape degausser unit	15
3.6.1	Tape conditioning	15
3.6.2	Tape reels	15
3.6.3	Automatic operation	15
3.6.4	Degausser cycle	15
3.6.5	Power requirement	15
3.6.6	Physical characteristic	15
3.7	Test fixture	15
3.8	Construction	16
3.8.1	Cabinets	16
3.8.2	Acoustic noise	16
3.8.3	Accessibility	16
3.8.4	Modular expansion	16
3.8.5	Integrated circuits	17
3.8.6	Cables	17
3.8.7	Chassis equipment	17
3.8.8	Alignment tools and test equipment	17
3.8.9	Panel lay-out sketches	18
3.8.10	Metal surfaces	18
3.8.11	Service life	18
3.8.12	Interference	18
3.8.13	Warm-up time	18
3.8.14	Environmental conditions	18
3.9	Reliability and maintainability	18
3.9.1	Reliability program plan	18
3.9.2	Maintainability program plan	20
3.9.3	Preliminary design review	21
3.10	Accessory	21
3.10.1	Test tape	21

TABLE OF CONTENTS (cont'd)

			Page No.
Section 4.		QUALITY ASSURANCE PROGRAMS	22
	4.1	General	22
	4.2	Design qualification tests	22
	4.2.1	Service conditions	22
	4.2.2	Normal test conditions	23
	4.3	Type tests	25
	4.3.1	Service conditions	25
	4.3.2	Normal test conditions	25
	4.4	Production test	26
	4.4.1	Normal test conditions	26
	4.5	Thermal design tests	27
	4.6	Reliability and/or maintainability demonstration tests	27
	4.7	Reliability conditioning test	27
	4.8	Maintenance records	27
Section 5.		PREPARATION FOR DELIVERY	28
	5.1	General	28
Section 6.		NOTES	28
	6.1	Note on information items	28
	6.2	Intended use	28